NT 10 Ethernet Transceiver
User's Manual

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NT10
ETHERNET
TRANSCEIVER

User Manual
(UM-NT10)

INTERLAN

NT10 ETHERNET TRANSCEIVER
USER'S MANUAL

(UM-NT10)

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TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

1.0 GENERAL DESCRIPTION

The NT10 Ethernet Transceiver Unit is a device for connecting an Ethernet controller or other Ethernet-compatible equipment to Ethernet coaxial cable. It is operationally compatible with the DEC-Intel-Xerox Ethernet specification, Version 1.0, September 1980. It goes beyond that specification in several ways. It contains circuitry to prevent an excessivly long transmission from being sent. This guarantees that a malfunctioning controller will not be able to disrupt network communication. The same circuitry prevents component failures in the transceiver from disrupting the network communication of other users.

The NT10 also contains an optional collision-detection test capability, so that the proper functioning of the collision detection circuit can be verified by the user while the unit is in service and without bringing down the network. This test capability is often called a Heartbeat test.

1.1 FEATURES

The NT10 is divided into four functional sections: transmitter, receiver, collision detector, and power converter. A full functional description of these sections is given in Chapter 3.

The unit is housed in an insulated metal case that provides protection for the circuit board and shielding against electromagnetic interference, both from external sources and radiation from the unit itself. The unit provides isolation between the coaxial cable, the case, and the transceiver cable.

It connects to the coaxial cable by means of a unique piercing tap. This allows attachment of an Ethernet station to an operational network without interupting network communication. A full description of the technique for connecting an NT10 to Ethernet coaxial cable is given in section 2.3.

The NT10 derives its power from the controller to which it is connected. That controller must provide a source of +12 to +15 Volts DC. The transceiver can operate over this wide range without malfunction or loss of reliability.

1.2 SPECIFICATIONS

The following specifications apply, unless stated otherwise, when the unit is operating in still air with an ambient temperature between 5 and 55 degrees Celsius, with relative humidity between 5 to 90 per cent non-condensing, and with a supply voltage of 11.4 to 15.75 Volts delivered through a source impedance of less than 4 ohms. (A 12 Volt +/- 5% power supply driving up to 50 meters of Ethernet transceiver cable will meet these voltage requirements.)

SPECIFICATIONS

PARAMETER	TYPICAL VALUE	WORST CASE	ETHERNET SPEC.
RECEIVER SECTION			
Leakage current	-20 uA	0 to -50uA	+2 to -50 uA
Input impedance			
coax cable tap	>250 kOhms	>100 kOhms	>50 kOhms
	6 pF	9 pF	4 pF
Delay time input to output			
Turn-on	50 ns	300 ns	500 ns
steady-state	20 ns	30 ns	50 ns
Waveform Symmetry	+/-1 ns	+/-2 ns	+/-2 ns

Output Voltage	+/-.7V	+/-.55 to 1.1V (nominal)	+/- 700 mV
TRANSMIT SECTION			
Output current			
AC component	32 mA	28 to 38 mA	28 to 38 mA
DC component	41 mA	40 to 42 mA	40 to 42 mA
Waveform Symetry	+/-1nS	+/-2nS	+/-2nS
Delay time Input to output			
startup	100 nS	200 nS	200 nS
steady-state	30 nS	50 nS	50 nS
Signal Spectrum Harmonic			
second	-27 dB	-20 dB	-20 dB
third	-27	-20	-20
fourth	-40	-30	-30
fifth	-40	-30	-30
sixth	-50	-40	-40
seventh	-50	-40	-40
higher	-57	-50	-50

Input impedance (Ohms)			
differential	78	77.2-78.8	77.2-78.8
common-mode	18.5	18.3-18.7	18.5 nominal
frequency range	0 - 30 MHZ	0 - 30 MHZ	2 - 30 MHZ
Common-mode voltage range at input	0 - 30 Volts	0 - 5 Volts	0 - 5 Volts
Input voltage required for operation	+/- 275mV	+/-350 mV	
COLLISION DETECTOR			
Turn-on delay	350 nS	500 nS	500 nS
Output freq.	10 MHz	9 - 11 MHz	8.5 - 11.5 MHz
Turn-off delay	350 nS	500 nS	N/A
Interframe test signal (optional, see sect. 2.2)			
delay	1 uS	500 nS to 1.5 uS	
duration	1 uS	700 nS to 1.3 uS	

Output Voltage	+/-.7V	+/-.55 to 1.1V	+/- 700 mV (nominal)
Jabber Control Timeout	5 mS	3 mS	1.2 mS min.

POWER SUPPLY

Input voltage (Vdc)		11.4 - 15.75	11.4 - 15.75
Source resistance		4 Ohms Max.	4 Ohms Max.
Current	360 mA	500 mA	500 mA
Starting surge current (15.75 volt supply with a 1 mS rise time)	1.6 A	3 A	N/A

ENVIRONMENTAL

Operating temperature	5 to 55 degrees Celsius
Operating humidity	5 to 90 percent non-condensing

Electromagnetic susceptibility:
unit will operate properly in the following externally applied fields.

10 kHz to 30 MHz	2 Volts/Meter
30 Mhz to 1000 Mhz	5 Volts/Meter

Electromagnetic radiation:
meets FCC part 15, subparagraph J, Class A limits

measured radiation:
highest amplitude component in each frequency range is stated below.
Measurements were taken at 3 meters and extrapolated to 30 meters.

frequency	measured	Class A limit	Class B limit
30 - 88 MHz	1.7 uV/M	30 uV/M	10 uV/M
88 - 216	7.0	50	15
216 - 1000	8.0	70	20

Notes: Class B limit are shown for informational purposes only. The NT10 is a Class A computer peripheral within the meaning of Part 15 of FCC Rules. IT IS THE RESPONSIBILITY OF THE PERSON WHO SELLS THE SYSTEM OF WHICH THE NT10 MAY BE A PART TO ENSURE THAT THE TOTAL SYSTEM MEETS THE ALLOWED LIMITS OF CONDUCTED AND RADIATED EMISSIONS.

Isolation:
500 Vac 50/60 Hz
applied between the shield of the coaxial cable and the shield of the transceiver cable or transceiver case.

Non-operating temperature:
-20 to +85 degrees Celsius

PHYSICAL DATA

Dimensions
4.125 by 8.8 by 3.5 inches
(10.5 by 22.4 by 9 centimeters)

Weight: 1.75 pounds
(0.80 kilograms)

Mounting method:
double-ended keyholes in end flanges
(spacing between keyholes , 2" x 7.937" center to center)

Power indicator:
LED indicator indicates presence of applied power and operation of internal power converter circuitry.

Orientation: Any orientation is allowed.

Coaxial Cable dimensions:
0.405 inch OD nominal per Ethernet spec.

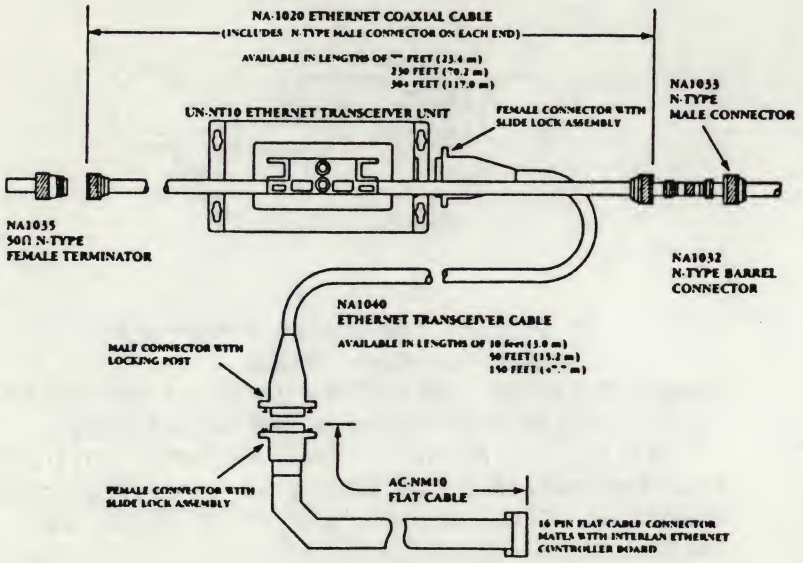
Transceiver Cable connections:

Pin 1	shield	9	collision -
2	collision +	10	transmit -
3	transmit +	11	n/c
4	n/c	12	receive -
5	receive +	13	power
6	power return	14	n/c
7	n/c	15	n/c
8	n/c		

1.3 RELATED PRODUCTS AND ACCESSORIES

Interlan provides a complete line of cables, connectors, terminators, and tools for completing the network installation.

Model Number	Description
UN-NT10	Ethernet Transceiver; includes five sets of replacement braid picks.
IK-NT10	Installation kit for the NT10; includes user manual (UM-NT10), drill clamp for coaxial cable, drill bit, and allen wrench.
NA1040-010 NA1040-050 NA1040-150	Ethernet transceiver cable with with connectors; in 10, 50, and 150 foot lengths (3.0, 15.2, 47.7 meters)
AC-NM10-10	Flat cable with connectors; 10 feet long (3 meters).
NA1020-077 NA1020-230 NA1020-384	Ethernet Coax Cable with connectors; 50 ohm cable with a .405" O.D. in 77, 230, 384 foot lengths (23.4, 70.2, 117.0 meters).
NA1032	N-Type barrel connector
NA1035	50 ohm N-Type female terminator



Ethernet Transmission Products

CHAPTER 2

INSTALLATION AND TESTING

2.1 UNPACKING AND INSPECTION

To protect against damage during shipment, each NT10 is packed in a special carton. The NT10 and documentation in the package should be inspected upon receipt for any possible damage. In the event of apparent damage to the unit, the carrier responsible for delivery and Interlan Customer Service should be notified promptly.

It is a good idea to keep the packing material the NT10 came in so that it may be returned for service in the future if the need should arise.

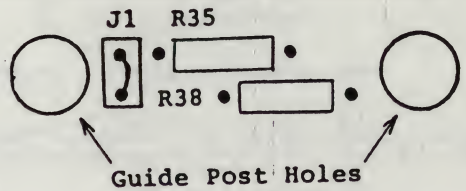
2.2 DISABLING THE COLLISION TEST OPTION

The NT10 is shipped from the factory with an optional capability to test the collision detection circuitry (a "heartbeat" test). (See section 3.4 for a detailed explanation of this optional feature) If you want to disable the collision detection test, it is necessary to open the NT10 case and cut a jumper. DO NOT ATTEMPT TO CUT THE JUMPER ON A TRANSCEIVER THAT IS CONNECTED TO AN OPERATING NETWORK AND HAS POWER APPLIED.

To disable the Collision Detection Test option:

a) Remove the NT10 bottom cover by unfastening the four screws in the cover.

b) Cut the jumper located near the middle of the circuit board at the location marked J1.



c) Replace the bottom cover and tighten the four screws.

Note: Interlan controllers in the A series and later utilize the collision detection test capability of the NT10. We recommend leaving the feature enabled as an assist in verifying proper operation of the transceiver on an operating network.

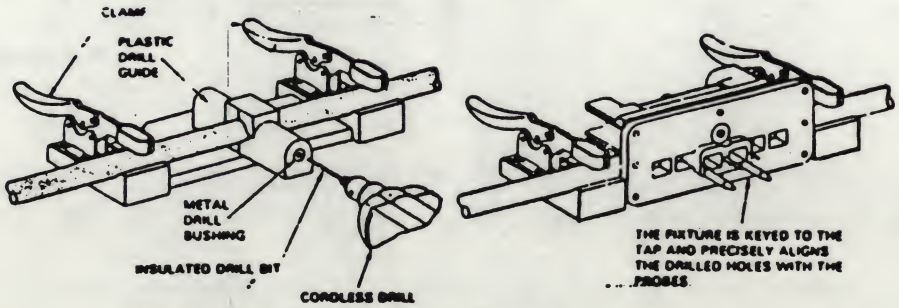
2.3 MOUNTING THE TRANSCEIVER ON THE COAXIAL CABLE

The following sequence should be followed to mount the transceiver on a coaxial cable. Only Ethernet coaxial cable is specified to be compatible with the NT10 tap. The tools necessary for mounting the transceiver are available in the Interlan Ethernet Transceiver Installation Kit (Interlan part number IK-NT10)

a) Place the drilling fixture onto the cable. Set the clamps to hold the cable firmly. Fit the drill

guide over the cable.

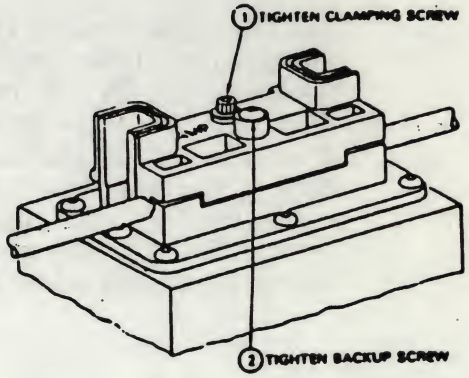
b) Using a high speed insulated drill and the drill bit with depth limiting collar, drill through the insulation and shield of the cable on both sides. Do not apply any unessersary pressure on the cable when drilling. The holes in the drill guide locate the drilling points. Drill to the depth allowed by the limiting collar on the bit and remove the drill bit without shutting the drill off. Remove the drill guide but leave the drill fixture on the cable. Insure that no braid fragments remain in the holes



c) Remove the upper tap section from the transceiver by loosening the clamping screw and sliding the piece up and off.

d) Align the transceiver with the drill fixture so that the lower

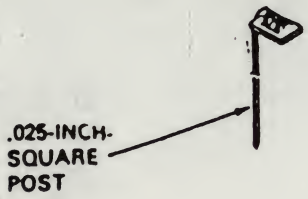
tap section is aligned with the cable and the holes in the cable are positioned over the probe.



e) Slide the upper tap section back onto the lower tap section. Tighten the clamping screw first, then tighten the backup screw.

f) Remove the drill fixture from the cable. You are now ready to connect the transceiver to a controller and verify proper operation. See sections 2.4-2.6.

In cases where it is necessary to remove the transceiver from the cable, follow the sequence in reverse. It is not necessary to use the drill fixture. When the transceiver has been removed from the cable, replace the braid picks with new ones. The braid picks are bent to conform to the cable during installation. They can only be used once. Extra braid picks are included with each transceiver and each installation kit.



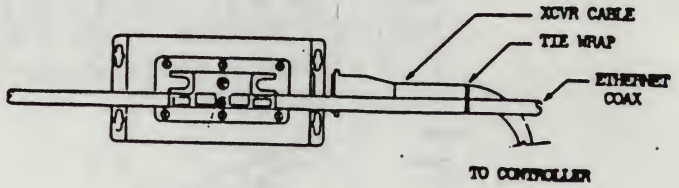
Braid pick

2.4 CABLING TO A HOST SYSTEM

The NT10 mates with a standard Ethernet transceiver cable (Interlan Part NA1040-XXX). This is a shielded twisted pair cable with 15-pin D connectors on each end. Slide locks on the cable mate with locking posts on the NT10 to insure the transceiver cable does not fall off the

NT10 accidentally.

Connect the female end of the cable to the NT10 and engage the slide locks. DO NOT ALLOW THE WEIGHT OF THE CABLE TO EXERT EXCESSIVE STRESS ON THE NT10 CONNECTOR. Tie-wrap or tape the cable to a secure point within 2 or 3 meters of the transceiver.



Securing the cable

At the host equipment, mount the grounding plate of the flat cable, AC-NM10-10, on a convenient place such as the mount rail on the rear of the equipment cabinet. Connect the twisted pair cable to the receptacle of the flat cable that is mounted on the grounding plate. See section 2.5 for details on grounding these cables.

Route the flat cable within the host equipment to the controller board. Connect the flat cable connector to the corresponding receptacle on the controller board.

The cabling is now complete.

2.5 GROUNDING

Both safety and electrical integrity require that the shields of the transceiver cable be connected to power system reference, or "ground". The grounding plate of the flat cable, AC-NM10-10, is intended to be mounted on the host equipment cabinet frame. The frame should be connected to the ground wire of the AC supply.

It is the responsibility of the user to provide the correct ground connection for the cables.

2.6 VERIFICATION TESTING

Having installed the transceiver and connected the cables, it is a good idea to verify that everything is working before going any further.

To verify the installation, run a test program that loops back a packet through the transceiver. Successful completion of this test indicates a complete and correct installation. Interlan diagnostics (DS-NI1010) provide such a test. It is called *NLBTST. It can be run when the diagnostic prompt asks for the name of the test to be run next.

In case of difficulty, check all connections and power to the transceiver. Power presence is indicated by the illuminated indicator next to the D-connector on the NT10.

CHAPTER 3

FUNCTIONAL DESCRIPTION

3.0 GENERAL DESCRIPTION

The NT10 is a transceiver, that is a combination transmitter and receiver in one physical package. It connects an Ethernet station, such as a minicomputer or work station, to the coaxial cable that links the networked stations together. Functionally, the NT10 consists of several parts:

* A Receiver. This is an electronic circuit that receives signals from the coaxial cable, conditions them for retransmission to the host, and transmits them over the transceiver cable to the host station.

* A Transmitter. This is an electronic circuit that receives data signals from the host station and transmits them on the coaxial cable.

* A Collision Presence Detector. This is an electonic circuit that monitors the signals on the coaxial cable and sends a "Collision Presence" signal to the host when a collision is present on the cable.

* A Power Converter. This is an electronic circuit that converts the 12 to

15 Volt (nominal) power supply from the host to the regulated values required by the transceiver's circuitry.

* A Cable Tap. This is a mechanical device that provides the physical and electrical connection between the transceiver electronics and the coaxial cable.

* A Case. This is an insulated metal box in which the transceiver circuit board is mounted and on which the cable tap is mounted. It serves to protect the transceiver circuitry from environmental stresses and electromagnetic fields, and it prevents unwanted radiation from the NT10. The case also acts as a heat sink for the power converter.

A functional diagram of the NT10 is given in Figure 3.0

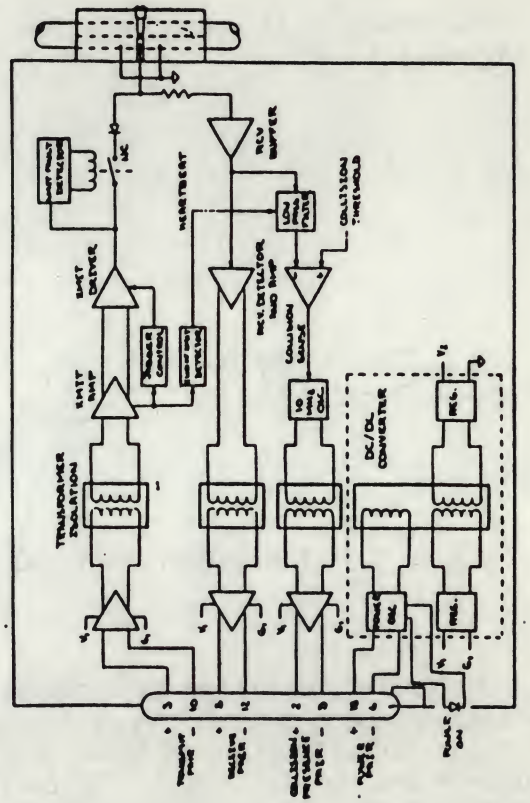


Figure 3.0 Functional Diagram of NT10

3.1 RECEIVER

The receiver is shown in a functional diagram in Figure 3.1.

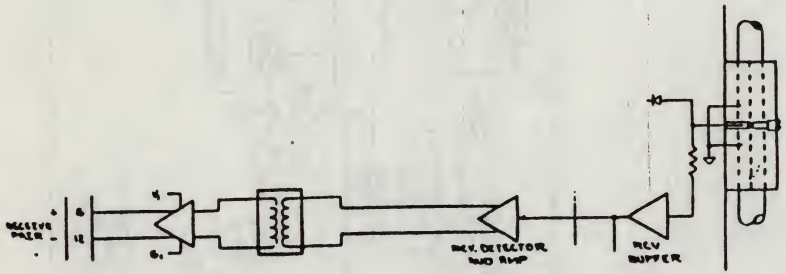


Figure 3.1 Receiver Functional Diagram

The buffer amplifier is a circuit that provides adequate signal energy to the rest of the receiving circuit with negligible effect on the signal on the coaxial cable. It provides the signal to the collision detector and to the interstage driver that removes the offset and drives the output circuit through an isolating transformer. The output circuit sends the received signal, at the proper voltage, to the host station over the "receive" pair of the transceiver cable. The signal is differential from the interstage driver on.

3.2 TRANSMITTER

The transmitter circuit is shown in a functional diagram in Figure 3.2.

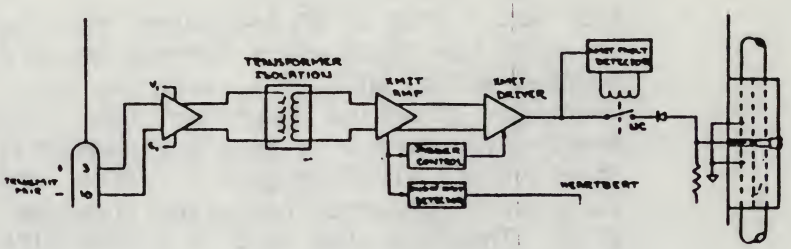


Figure 3.2 Transmitter Functional Diagram

The Input Stage amplifies the data signal received from the host station over the "transmit" pair of the transceiver cable. It drives the Driver Stage through the isolation transformer. The Driver Stage sends the data signal to the Current Driver and to the two "jabber control" timers that prevent excessively long transmissions by disabling the Current Driver.

The Current Driver is the circuit that sends the signal onto the Ethernet cable. It provides the proper offset, amplitude, and waveform characteristics required by the Ethernet specification.

Between the output of the Current Driver and the connection to the coax, the signal passes through a relay contact. Controlling this relay is a third timer circuit. This one detects any fault, either a long transmission from the host or any other fault that would cause the Current Driver to be turned on longer than a reasonable time. The timer will open the relay and disconnect the transmitter from the network if it is not reset by the end of transmission.

3.3 COLLISION DETECTOR

The presence of a collision, two or more stations transmitting at the same time, is detected by the Collision Detector circuit. This circuit compares the average signal voltage on the coax with a reference voltage. When the average signal voltage exceeds the reference, a 10 MHz oscillator is turned on and its signal sent, through an isolation transformer and driver circuit, to the host station on the "collision presence" pair of the transceiver cable.

A functional diagram of the collision detector is shown in Figure 3.3.

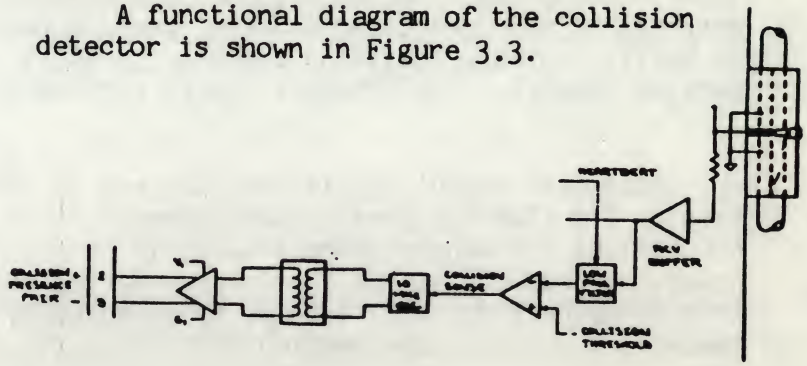


Figure 3.3 Collision Detector Diagram

3.4 COLLISION TEST OPTION (The Heartbeat Test)

During normal network operation, collisions occur very seldom. In order to be able to test the collision detection circuit while the transceiver is in use, a special test capability has been built in.

At the end of each transmission through the NT10, a short pulse is sent to the input of the collision detection circuit. This pulse will turn on the oscillator during the 9.6 microsecond interframe period. The oscillator signal can be detected by the controller and its presence used to verify that the collision detector is still working properly. This test is often refered to as a heartbeat test.

This test capability is not required in the Version 1.0 Ethernet spec. Some Ethernet controllers may behave unpredictably if a collision presence signal is received during the interframe period. The test may be disabled by removing a jumper. See section 2.2.

Interlan controllers behave predictably when the test signal occurs. (The standard series controllers set the packet-missed bit and the A series controllers ignore this signal except when performing the Test Collision-Presence command.)

3.5 POWER CONVERTER

The Power Converter is a DC-to-DC converter that provides isolated and regulated voltages to operate the NT10. It is capable of reliable operation across the full range of supply voltages implied by the Ethernet spec. When power is applied to the transceiver and the oscillator in the DC-DC converter is operating, the power-on LED located near the transceiver cable connector will be lit.

3.6 CASE AND CABLE TAP

The NT10 is housed in an insulated metal case. This serves as protection and electrical shielding for the circuit board, and has mounting holes to allow the NT10 to be fastened or tied to a user-provided mounting point. The double ended key-hole design of the mounting holes allows the mounting screws or studs to be installed before the transceiver is installed. The transceiver slips over the screw heads in either orientation, with the transceiver cable exiting from either end.

In normal operation, the transceiver case will be slightly warm to the touch. This is because the case is used as a radiating surface to cool the transceiver electronics. It provides close thermal contact with an internal heat sink. This minimizes temperature rise inside the case and contributes significantly to the reliability of the unit.

CHAPTER 4

MAINTENANCE

4.0 GENERAL

Maintenance of the NT10 is minimal under normal operating conditions. Its design is such that operation for years without failure should be the norm.

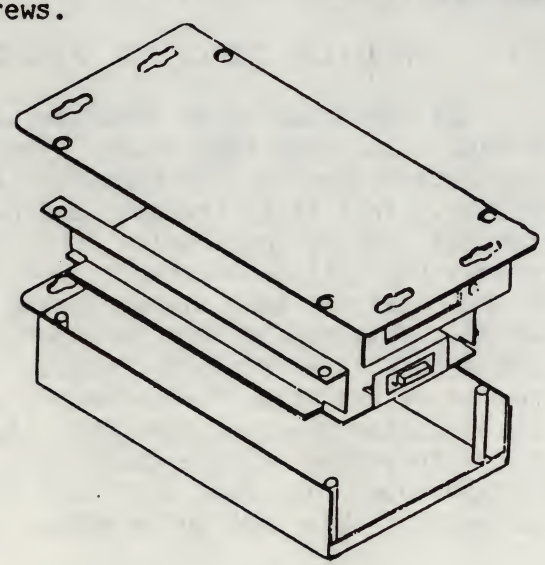
4.1 OPERATING CHECKS AND FAILURE SYMPTOMS

The operation of an NT10 can be checked by sending a loopback test frame. Interlan diagnostics provide this test function in test *NLBTST. This tests transmit and receive circuits, and by implication, the power converter. To test the collision circuit, verify the presence of the collision test signal during the interframe period. This can be done in Interlan contollers that support the "Perform Collision Detect Test" command by executing that command, or by viewing the collision presence indicator light on controllers that provide them, or with an oscilloscope. The Collision Test option must be enabled for this test to be effective.

4.2 CIRCUIT BOARD REPLACEMENT

To replace the circuit board, it is not necessary (or desirable) to disconnect the transceiver from the network cable. Remove the four screws on the transceiver bottom plate and remove the bottom plate itself. Carefully slide the circuit board out until it is clear of the tap guide posts.

To replace the board, carefully slide the circuit board down over the guide posts and replace the bottom plate. Replace and tighten the four screws.



4.3 PRODUCT WARRANTY

Interlan warrants that the products covered hereby shall be free from defects in material and workmanship for a period of one (1) year from the date of initial shipment by Interlan. The foregoing warranty does not apply to any products which have been subject to misuse, neglect, accident, or modification.

If found defective by Interlan within the terms of this warranty, Interlan's sole obligation shall be to repair or replace at Interlan's option the defective product and carry out the unexpired term of the warranty which was applicable to the defective product. All replaced products become the property of Interlan.

As a condition of this warranty, customers must (1) obtain an Interlan Return Authorization Number (RAN), and shipping instructions, (2) return all products (or approved subassemblies) transportation prepaid and insured to Interlan's Westford, Massachusetts facility or other specified location, and (3) include a written description of the claimed defect.

If Interlan determines that the product is not defective within the terms of this warranty, the Customer shall pay all costs of handling and return postage; otherwise normal transportation charges for the return to the Customer shall be paid by Interlan, within the United States only. This warranty excludes all costs of shipping

outside of the United States, Customs clearance and other related charges.

Except for the express warranties stated above, Interlan disclaims all warranties on products including all implied warranties of merchantability and fitness; and the stated express warranties are in lieu of all obligations or liabilities on the part of Interlan.

4.5 SERVICE POLICY

Should a product fail while under the terms of the warranty agreement, it will be repaired or replaced free of charge. For out-of-warranty service, repairs are charged on a time and materials basis.

To return a product for out-of-warranty repair:

1. Contact the factory for an Interlan Return Authorization Number (RAN), shipping instructions, and a non-binding repair cost estimate.

2. Return the product (or approved subassembly) transportation prepaid and insured to Interlan's Westford, MA. facility (or other specified location) with the RAN marked on the outside of the package.

3. Include a written description of the product's symptomatic problem, and the name and telephone number of a technical contact.

4. Include a purchase order number for an amount equal to the estimated repair cost, and the name and telephone number of a purchasing contact.

If Interlan determines the product not to be

repairable for less than the quoted estimate repair cost, Interlan will notify the purchasing contact for repair authorization before proceeding. In all cases repairs are performed and charged on a time and material basis, and the product is returned with transportation charges prepaid and billed.

Repair is performed at the factory only, typically within a 72 hour turnaround time. To avoid delay in processing the return, it is absolutely necessary to return products in the manner stated above.

All repairs are warranted for a period of 30 days after return to the customer.